

NEUTRON RADIATIVE CAPTURE ON ULTRA-MAGNETIZED ATOMIC NUCLEI

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During past decade the observations of soft gamma repeaters (SGRs) and anomalous X-ray pulsars (AXPs) brought numerous evidences in support of a ‘magnetar’ concept suggesting enormous magnetic fields in supernovae and nascent neutron stars with a strength ranging up to $B \sim 10^{17.5}$ G (see, e.g., [1] and refs. therein). Assertion of a possibility of ultra-magnetized stellar media rises the question of the effect of magnetic field in nuclide transformations. In this contribution we consider an example of (n, γ) reactions involving ultra-magnetized atomic nuclei.

Employing the Hauser-Feshbach statistical approach the important magnetic field effects in neutron radiative capture are argued to originate from modifications of nuclear level densities and γ -transition energies. The relationship between these contributions as well as the sensitivity to approximations are illustrated on schematic examples of neutron capture by neutron-odd nuclei which yield exit channel even-even nuclei corresponding to ^{44}Ti and ^{56}Ni .

As shown the magnetic energy leads to re-distribution of spin-states in out-channel. The largest contribution of resulting zero-spin nucleus at zero field sharply vanishes with increasing field strength, while the population of the highest allowed spin-states grows. This results in nearly constant cross section in weak field limit. In magnetic fields of large strengths such highest spin-states of final nuclei give predominant contribution to the total cross section because of large extra-energy in γ -channel. Strong magnetic field results in considerable enhancement of radiative n -capture process. Such a magnetocatalysis is considerably stronger for larger values of nuclear g -factor. The magnetic change of level spacing reflects magnetic effect in nuclear structure [2] and gives rise to oscillations of n -capture cross section around an enhancement caused by magnetic energy. Contribution of such oscillations is particularly important for relatively small absolute values of g -factors. The magnetic effects in level spacing gives rise to considerably different cross section ratios for ^{56}Ni and ^{44}Ti nuclei. For the case of product-nucleus ^{56}Ni , with closed shell at zero-field, n -capture process displays stronger enhancement, while for ^{44}Ti the reaction can be suppressed at weak fields.

1.C. Thompson and N. Murray, *ApJ* **560**, 339 (2001);

2.V.N.Kondratyev, *Phys. Rev. Lett.* **88**, 221101 (2002); *J. Nucl. Sci. Tech. Suppl.* **2**, 550 (2002); *J. of Nucl. and Radiochem. Sci.* **3**, 205 (2002)